Challenges to Providing Open Heart Surgery for 186 Million Nigerians

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Abstract: Open heart surgery is nonexistent or undeveloped in many African countries due to the prerequisite for specialized multispecialty teams, expensive equipment, and consumables. This review aims to outline strategies for facilitating local skilled workforce training, improve patients' access, and sustain heart surgery in Africa's most populous nation. Methods: We reviewed the demographic, socioeconomic, and health metrics published by the United Nations, the World Health Organization (WHO), the World Bank, and other relevant sources for the top three African economies – South Africa, Nigeria, and Egypt. Results: South Africa classified as upper-middle-income nation with gross national income [GNI] 12, 4754126 spends 8.8% of gross domestic product (GDP), while Egypt and Nigeria both classified as lower-middle-income nations GNI 41251046 spends 5.6% and 3.7% of GDP, respectively, on health care. Egypt performed 45%, South Africa 39%, and Nigeria 0.1% of their WHO projected annual heart surgery volume in 2015. These capacities are consistent with the human development index (HDI), thoracic surgeon-to-population ratio, and health insurance coverage ranking of these countries. Conclusion: Although gross income per capita is comparable, the HDI - a better discriminator of development is higher in Egypt with 0.69 against 0.51 in Nigeria, as evidenced by their respective heart surgery capacities. While the WHO projected 72,000 cases/annum for Nigeria is unattainable with the present workforce, the Pan African Society for Cardiothoracic Surgery (PASCATS) 40/1 million population projection of 7200 cases/annum appears a more realistic goal. However achieving even this modest target will require government political willpower and increased budgetary allocation for expanding insurance coverage. PASCATS advocates three mentorship models: resident senior local consultant, mission teams and senior expatriate consultant, with centralization through regional referral centers as viable pathways to develop cardiac surgery in sub Saharan Africa. Regionalization optimizes the scarce workforce and resources and therefore by combining assets can fast track skill acquisition by trainee surgeons.

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Challenges to providing open heart surgery for 186 million Nigerians

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Abstract

Background: Open heart surgery is nonexistent or undeveloped in many African countries due to the prerequisite for specialized multispecialty teams, expensive equipment, and consumables. This review aims to outline strategies for facilitating local skilled workforce training, improve patients' access, and sustain heart surgery in Africa's most populous nation. **Methods:** We reviewed the demographic, socioeconomic, and health metrics published by the United Nations, the World Health Organization (WHO), the World Bank, and other relevant sources for the top three African economies – South Africa, Nigeria, and Egypt. **Results:** South Africa classified as upper-middle-income nation with gross national income [GNI] $12,475–$4126 spends 8.8% of gross domestic product (GDP), while Egypt and Nigeria both classified as lower-middle-income nations GNI $4125–$1046 spends 5.6% and 3.7% of GDP, respectively, on health care. Egypt performed 45%, South Africa 39%, and Nigeria 0.1% of their WHO projected annual heart surgery volume in 2015. These capacities are consistent with the human development index (HDI), thoracic surgeon-to-population ratio, and health insurance coverage ranking of these countries. **Conclusion:** Although gross income per capita is comparable, the HDI - a better discriminator of development is higher in Egypt with 0.69 against 0.51 in Nigeria, as evidenced by their respective heart surgery capacities. While the WHO projected 72,000 cases/annum for Nigeria is unattainable with the present workforce, the Pan African Society for Cardiothoracic Surgery (PASCATS) 40/1 million population projection of 7200 cases/annum appears a more realistic goal. However achieving even this modest target will require government political willpower and increased budgetary allocation for expanding insurance coverage. PASCATS advocates three mentorship models: resident senior local consultant, mission teams and senior expatriate consultant, with centralization through regional referral centers as viable pathways to develop cardiac surgery in sub Saharan Africa. Regionalization optimizes the scarce workforce and resources and therefore by combining assets can fast track skill acquisition by trainee surgeons.

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Full Text

Introduction

Open-heart surgery (OHS) although introduced into clinical practice over half a century ago remains out of reach to a third of the World's population, mostly domiciled in Africa. Nigeria, the most populous in Africa and seventh largest in the World, has a substantial percentage of these patients lacking access to heart surgery. Limited financial resources, dearth of trained workforce, inadequate infrastructures, largely nonexistent health insurance coverage, and high poverty rates are mitigating factors to sustaining heart surgery programs and by corollary workforce training in Sub-Saharan Africa (SSA). Bridging this disparity gap with the developed world will entail novel solutions unique and adaptable to the local environment.

Methods

We performed a comparative analysis of the top three African economies: South Africa, Nigeria, and Egypt. India was included because it has a western-standard technologically advanced health care despite having the world's largest indigent population compared to Nigeria with the second largest indigent population and poor health-care system. Online searches of the demographics, socioeconomic, health policies, expenditures, and workforce for these countries published by the United Nations, the World health organization (WHO), the World Bank, and other relevant sources were compiled for analysis. The country economic classification was based on the gross national income per capita (GNI/capita) as defined by the World Bank[1] [Table 1]. Comparative analytic metrics utilized to assess wealth, education, standards of living, and health care were gross domestic product per capita (GDP/capita), adult literacy, human development index (HDI), health-care workforce, percentage GDP spent on health care, and average life expectancy. Extreme poverty level was calculated based on the mean of the national poverty levels for the poorest 15 countries, for which national poverty levels were available and defined by the World Bank as living on <$1.25 a day.[2]{Table 1}

Results

Population

Nigeria's estimated population of 186 million, seventh in the World and first in Africa, is equally distributed between urban and rural areas, with 45.1% under the age of 15 years and 4.8% above 60 years. The adult literacy rate is 61.3% and average life expectancy is 53.4 and 51.7 years for women and men, respectively. It has the second largest population of people living under extreme poverty.

Egypt's estimated population of 90 million is 15th in the World and 3rd in Africa, with 43.5% living in urban area, 32.1% under 15 years, and 7.5% over 60 years. Adult literacy rate is 72.0% and life expectancy is 75.5 and 71.6 years for women and men, respectively.

South Africa's estimated population of 54 million is 25th in the World and 5th in Africa, with 62.0% residing in urban area, 30.3% under 15 years, and 7.3% over 60 years. Adult literacy rate is 88.7% and life expectancy is 54.1 and 53.1 years for women and men, respectively.

India's estimated population of 1.3 billion, second largest in the world, has 31.3% resident in urban area, 30.8% under 15 years,

and 7.5% over 60 years. Adult literacy rate is 62.8% and life expectancy is 67.6 and 64.4 years for women and men, respectively. India also has the world's largest population of people living under extreme poverty.

Economy

Nigeria had surpassed South Africa as the largest African economy in 2014, but with subsequent recession and devaluation of the local currency in 2016, this status has reversed. According to 2016 ranking of the top 20 economies in Africa based on GDP, Nigeria leads with $594 billion, followed by South Africa $341 billion and Egypt third with $275 billion.[3] However, the International Monetary Fund recalculation in August 2016 using the current exchange rate shows South Africa again at the top.[4] India with a GDP of $2.2 trillion is ranked 7th in the world.[5] GDP has commonly been used as an indicator of a country's economic health and a gauge of the standard of living. However, with the World Bank economic classification which is based on GNI/capita, South Africa is considered the wealthiest and classified as upper-middle income, while Nigeria, Egypt, and India are all lower-middle income. GNI/capita for high-income economies is defined as $12,746 and above, upper-middle income $12,475–$4126, lower-middle income $4125–$1046, and low income $1045 or lower[1] [Table 1] and [Figure 1]. The health expenditure (% of GDP) for 2014 was highest in South Africa at 8.8% and lowest in Nigeria at 3.7%.[6] The HDI, a composite statistics of life expectancy, educational attainment, and per capita income, is designed to give a better assessment of development and which can also be used to demonstrate how two countries with similar levels of GNI can end up with different HDI depending on the national policy choices. Among the four countries under comparison, Egypt has the highest HDI 0.69 and is ranked 108, followed by South Africa 0.66 ranked 116, India 0.609 ranked 130, and Nigeria 0.514 ranked 152 in the world[7] [Figure 2].{Figure 1}{Figure 2}

Health services, workforce, and heart surgery volume

Nigerian public health services are delivered at three levels and funded by the three tiers of government as per the constitution. Primary care services are administered and funded by the local governments, secondary care provided at general hospitals funded by the state governments, and tertiary care at specialist and teaching hospitals by both state and federal governments. The private sector delivers mainly primary and secondary care, with a few offering specialist care services.

The Nigerian general health-care workforce and annual output is relatively large compared to other countries in SSA [Table 2] and [Table 3]. However, for thoracic surgery specialty, there is a large disparity between Nigeria and the other two African countries under review. Egypt has the highest number of thoracic surgeons and OHS programs [Table 4]. At present, in Africa, Egypt also performs the highest volume of heart surgery, while Nigeria performs the lowest, approximately 100 cases/annum [Table 5].{Table 2}{Table 3}{Table 4}{Table 5}

Discussion

About 80% of global cardiovascular disease (CVD) burden has been estimated to occur in low- and middle-income countries. Although HIV/AIDS currently is the leading cause of death in Africa followed by CVD, in patients older than 45 years, CVD remains the foremost cause of death mostly from stroke and hypertensive congestive heart failure.[8],[9] While the incidence of ischemic heart disease is presently very low, it is expected to increase over the coming decades. However, rheumatic heart disease (RHD) continues to be a major cause of heart failure and disability in children and young adults.[10] It has been estimated that 2% of the aboriginal people of Northern Australia of all ages have RHD.[11] Extrapolating the 2% figure from this study to West Africa, an estimated 3.6 million Nigerians and 0.5 million Ghanaians under 55 years suffer from RHD.[12],[13] Overall, CVD-related deaths are expected to double in SSA over a 30-year span between 1990 and 2020.[14] In spite of this CVD disease burden and the projected increase over the next decade, Africa lacks the skilled workforce required to handle this load. Comparing the world thoracic surgery workforce, Western Europe has the highest surgeon-to-population ratio of 27.8, followed by North America 26.7, South America 2.6, Asia 0.99, and Africa distant last with 0.26/million.[15] The magnitude of the workforce shortage can be put in perspective when juxtaposed to the WHO's estimated projection of 400 OHSs/million population a year. Although debatably this projection may not be entirely realistic to apply uniformly between the industrialized world and third world nations for several reasons. The CVD disease patterns are different, with congenital and RHD being prevalent in developing nations as compared to ischemic and degenerative heart diseases in the developed nations. Moreover, the average male and female life expectancy in SSA of 53.2 and 55.0 is significantly lower when compared to the Euro area with 79.5 and 85.1 and United States with 76.2 and 81.3 years, respectively.[16] Applying the WHO annual heart surgery volume per million population

formula in Nigeria would translate to approximately 72,000 cases compared to the present minuscule number of approximately 100 cases. A conservative estimate of 356 busy cardiothoracic surgeons performing 200 cases each will be required to meet the WHO target. The present workforce deficit is, however, enormous, with approximately 40 cardiothoracic surgeons, mostly doing general thoracic surgery, and only perhaps 4–5 capable of independently performing OHS. With 8 years' average length of thoracic surgery training after medical school graduation, and at the current 2–4 surgeons output per annum, it will take decades to bridge the workforce deficit without a paradigm shift by the government, national postgraduate medical college, and other stakeholders. Nonetheless, 1000 open-heart cases per annum can comfortably now be done by the current workforce of 4–5 proficient cardiac surgeons performing 200–250 cases each. This is possible, provided the National Health Insurance Scheme (NHIS) agrees to pay for these surgeries as part of a new government policy to improve patients access and fast-track local workforce training. This increased volume load will enable more practice hands-on experience for resident trainees and interested practicing surgeons until they transition to operating independently. NHIS can subsequently build on this framework by gradually increasing the number of funded OHSs as cardiac surgical capacity grows. This will gradually reduce the workforce deficit, especially with the estimated Nigerian population growth to 262 million by 2030.[17]

Training collaboration with related disciplines is also crucial due to scarcity of other support specialties such as invasive cardiologists, cardiac anesthesiologists, pulmonologists, intensivists, pharmacists, critical care nurses, and perfusionists. This multispecialty workforce deficiency is the single greatest obstacle and rate-limiting step to providing adequate OHS services in Nigeria. The WHO 2006 World health report identified lack of human resources as the greatest challenge to providing surgical care in developing nations. The WHO report further stated that simply funding and providing equipment will not completely address the health disparities between developed and developing nations without strategies to tackle workforce shortage. Africa is estimated to have 25% of the global burden of disease, but only 2% of the world's health workforce.[18] A worldwide surgical workforce review showed that Africa despite having three times the population of the United States has <1% the number of US surgeons.[19] Given the expense associated with OHS, the wealth of a nation obviously influences its ability to provide advanced technological medicine to its citizens. Among the top three national economies in Africa, Egypt has made the greatest stride at meeting the WHO OHS targets due to perhaps having the lowest cardiothoracic surgeon-to-population ratio of 1–183,673 followed by South Africa 1–323,352 and Nigeria a distant third with 1–4,500,000. India though more technologically advanced but burdened by the socioeconomic challenges of having the world's second largest population has 1–1,300,000 ratio. These findings are also consistent with the level of HDI, with Egypt having the highest HDI and Nigeria the lowest [Table 4]. South Africa the wealthiest however spends a greater percentage of its wealth, 8.8% of GDP on health care compared to 3%–6% among the other three nations. These figures nonetheless are all far below the target set at the April 2001 Abuja declaration meeting of African Union heads of state pledging to allocate at least 15% of their annual budget to improving the health sector, as part of meeting WHO millennium goals.[20] The second greatest barrier after inadequate workforce in Nigeria is the inability of majority of the population to pay for OHS without third-party health insurance or government subsidy for indigents. This is apparent from the observed correlation between percentage of population with health insurance coverage and volume of OHS in these different countries. Egypt which performs the highest number of heart surgeries has a health insurance scheme covering about 60% of the population, while South Africa provides health insurance coverage to a significant percentage of its population. Nigeria however has an undeveloped NHIS that reportedly covers <5% of the population and only primary care services. India faced with the world's largest numbers of indigents also has minimal insurance coverage for the 1.3 billion population. The countries with substantial health insurance coverage for its citizens therefore tend to perform closer to WHO predicted volume, with the highest in Egypt at approximately 45% and lowest in Nigeria at 0.14% [Table 5]. This is further supported by the United States experience which has insurance coverage for >80% of its population performing over 400% of WHO predicted volumes. Only half a century ago, the United States had similar access challenges to expensive services such as OHS until Congress in 1965 enacted Medicare and Medicaid to cover health-care costs for the elderly and the poor.[21] Despite being the wealthiest country in the world, without this provision, many US citizens today would have lacked access to technologically advanced lifesaving medical services except in emergencies. The US Congress in 1986 enacted a statute“Emergency Medical Treatment and Labor Act” to ensure public access to emergency services, regardless of ability to pay. This statute requires that a hospital treat and stabilize the emergency medical condition within its capability including inpatient admissions and surgery when necessary.[22] Despite these safety nets, medical bills associated with catastrophic illnesses remain the most common cause of bankruptcy in the United States. The reality is that any pathway to achieving unrestricted access to lifesaving OHS either in developed or in developing countries and sustainability in developing countries must include some form of government or third-party health insurance reimbursement. Without health insurance, OHS as currently priced will remain largely unaffordable and outside the reach of majority of the world's population needing surgery, including even cardiac surgeons who provide these services. A WHO report indicates that heavy reliance on out-of-pocket expenditures for medical services leads to financial barriers for the poor. Surveys of households showed that an average of 100 million individuals are impoverished and another 150 million individuals face financial difficulties any given year from health-care costs.[23] The United Nations members are all in agreement on the need for eventual implementation of universal health coverage (UHC), to be tailored to each country's socioeconomics and culture so everyone can

have access without financial hardship.[24] The WHO and the World Bank defines UHC as when all people receive the health services they need without suffering financial hardship when paying for them.[25] This is why former United States President Barack Obama recently warned against the dangers of repealing the Affordable Care Act enacted under his administration to provide all Americans access to high quality and affordable medical care with greater financial security.[26] India which has the world's largest indigent population and limited government insurance scheme has evolved a two-tier system to tackle its health-care delivery challenges: an expensive private care for the elite and a poorer quality public funded care for the poor. The 10% (130 million) elite in India in absolute numbers are larger than the elites in most rich developed countries, and so provides their private sector a large local pool that can afford care in addition to targeting the wider international community through medical tourism.[27],[28] Favorable government health policies, low-interest loans, and tax incentives over the preceding 2–3 decades facilitated opening of many heart hospitals, with skilled workforce recruitment of Indian health expert professionals trained in Europe and North America through financial incentives. This Indian two-tier model could work in Nigeria, given the similarities in their socioeconomic demographics. Nigeria like India has a sizeable upper and middle class comprising about 30% of the population, despite having the world's second largest indigent population. It has been estimated that over $500 million/annum is spent by Nigerians traveling abroad to India, Egypt, South Africa, Western Europe, and North America for medical tourism, drawn mainly from this 30% upper and middle class. However, the Indian model can only work if the current dearth of skilled heart team workforce is addressed. There are presently practicing in Nigeria four cardiac anesthesiologists, three interventional cardiologists, one perfusionist, and about two dozen trained OHS intensive care nurses. Compounding the low case volume needed to train more proficient cardiothoracic surgeons is the difficulty in attracting young bright entrants because of negative perceptions of the present and future status of the specialty in Nigeria. Many practicing thoracic surgeons are of the opinion that their remuneration is not commensurate with the length of training and that they lack private practice opportunities to supplement income as compared to other medical and surgical specialties in government employment. They also feel frustrated at lack of professional growth and fulfillment, due to the almost nonexistent opportunities to acquire and maintain needed cardiac surgical technical skills. Achieving proficiency in cardiac surgery even after completion of formal residency training requires a period of repetitive practice to hone and further improve surgical skills. Malcom Gladwell in his book, the Outliers,[29] states that human mastery of any complex task requires about 10,000 hours which usually takes about 10 years to attain. This rule is also probably applicable to cardiac surgery which requires complex brain and hand coordination. Unfortunately, however, the present status of cardiac surgical practice in Nigeria with the very low volumes cannot allow attainment of this mastery level for the average cardiac surgeon. Even when surgeons are sent on refresher courses to India, Egypt, and South Africa, they quickly lose any acquired skills on returning home because of the minimal OHS activities. At present, none of the heart programs can function independently and all depend on intermittent foreign teams visiting a few times a year. Since most of the surgical missions come with a full team aiming to perform as many cases as possible within their limited 10- to 14-day visit, they often do not allow much hands-on operating experience for the local surgeons. However, despite its limitations, this less than ideal model is better than the present state of doing nothing. Some knowledge can still be gained by observing OHS procedures without hands-on participation. Aldo Castaneda properly defined the efficiency of visiting heart teams: “It helps if an experienced (senior/retired) surgeon leads these efforts on a full time pro bono basis.” However, to more effectively transfer surgical skills requires a longer duration of mentorship to allow smooth transition to independent operating by the local team. This model though more expensive appeared to have worked in Vietnam, where Professor Alain Carpentier and his team from France at the invitation of the Vietnamese government established the Ho Chi Minh City Heart Institute in 1992. After 10 years of training and mentoring, the local team was finally able to confidently run independently.

For effective implementation of the Indian two-tier health system model in Nigeria, the government would need to attract back home their specialist physicians from Europe and North America by providing financial incentives, well-equipped hospitals that would allow for professional growth and fulfillment. Secondly, more of the indigent population would need to be enrolled into the NHIS to increase access to care at publicly funded hospitals and private hospitals which have contracted to provide these services to indigents at discounted government rates. The 30% upper and middle class who previously traveled overseas can be given incentives to redirect their money inward by seeking needed care at the local private and public hospitals. Even if these above objectives were attained, meeting the estimated WHO OHS annual volume would still be an impossible task for the foreseeable future. Given the peculiar socioeconomic and workforce challenges facing Africa, Pan-African Society for Cardiothoracic Surgery (PASCATS) has therefore recommended using a lower criteria of 40 OHS per 1 million population as a more realistic and achievable target goal for most African countries. Applying this PASCATS formula would mean that Nigeria should be performing 7200 cases per annum, rather than the 72,000 projection by the WHO. However, when applied to Egypt and South Africa, the estimated annual volumes of 3600 and 2160 OHS cases are significantly below their present volumes of 16,000 and 8500, respectively. This suggests that the PASCATS formula may be inappropriate for more medically advanced countries in Africa. The PASCATS formula can be applied only to public hospitals, and when the volume from private hospitals is eventually added, they may approach the WHO targets especially when universal health insurance becomes fully implemented. In its advocacy to improve OHS volumes in Africa, PASCATS has identified three models for developing cardiac surgery and

providing effective cardiovascular services to the underserved Sub-Saharan African population: resident senior highly qualified local consultant surgeon, visiting teams (1–2 missions a year) which are not integrated into the health-care system and not fully supported by the host health care policymakers due to economic constraints, and senior expatriate cardiac surgeon on contract and paid by the host government to develop a cardiac surgery program and organize capacity building.[15] Furthermore, PASCATS advocates for the development of regional referral cardiac centers in Africa to concentrate the scarce workforce in a few centers of excellence and thereby improve residency training, quality of service, and patients' outcome.

Conclusion

We have reviewed the possible strategies to improve patient's access, train skilled workforce, and sustain OHS programs. In addition, PASCATS also advocates consolidating existing heart programs into regional cardiac centers with possibly both public- and private-sector participation and a high-level political commitment with budgetary support for implementation.

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Conflicts of interest

There are no conflicts of interest.

References

1 Industrialization in Africa and Least Developed Countries. A Report to the G20 Development Working Group by UNIDO. Available from: http://www.unido.org/fileadmin/user_media_upgrade/Worldwide/G20_new_UNIDO_report_industrialization_in_Africa_and_LDCs.pdf. [Last accessed on 2018 Jun 12].

2 Monitoring Global Poverty: Report of the Commission on Global Poverty 2018.

3 Top 20 Largest Economies in Africa. DOI:10.1596/978-1-4648-0961-3. Available from: http://www.africaranking.com/largest-economies-in-africa/. [Last accessed on 2018 Jun 12].

4 South Africa Regains Africa's Biggest Economy Title from Nigeria. Available from: http://www.bbc.com/news/world-africa-37045276. [Last accessed on 2018 Jun 12].

5 Gross Domestic Product; 2015. Available from: http://www.databank.worldbank.org/data/download/GDP.pdf. [Last accessed on 2018 Jun 12].

6 World Health Organization Global Health Expenditure Database. Available from: http://www.data.worldbank.org/indicator/SH.XPD.TOTL.ZS. [Last accessed on 2018 Jun 12].

7 United Nations Development Programme: Human Development Reports. Available from: http://www.hdr.undp.org/en/countries. [Last accessed on 2018 Jun 12].

8 World Health Organization: Cardiovascular Diseases (CVD). Available from: http://www.who.int/mediacentre/factsheets/fs317/en/. [Last accessed on 2018 Jun 12].

9 Heart of Soweto Study. Available from: http://www.hefssa.org/static/heart-of-soweto-study. [Last accessed on 2018 Jun 12].

10 WHO Regional Office for Africa Fifty-fifth Session. Cardiovascular Diseases in the African Region: Current Situation and Perspectives. Maputo, Mozambique: WHO Regional Office for Africa Fifty-fifth Session; 2005. p. 22-6.

11 Carapetis JR. Rheumatic heart disease in developing countries. N Engl J Med 2007;357:439-41.

12 Nigeria Demographics Profile 2016. Available from: http://www.indexmundi.com/nigeria/demographics_profile.html. [Last accessed on 2018 Jun 12].

13 Ghana Demographics Profile 2016. Available from: http://www.indexmundi.com/ghana/demographics_profile.html. [Last accessed on 2018 Jun 12].

14 Gaziano TA. Economic burden and the cost-effectiveness of treatment of cardiovascular diseases in Africa. Heart 2008;94:140-4.

15 Yankah C, Fynn-Thompson F, Antunes M, Edwin F, Yuko-Jowi C, Mendis S, *et al.* Cardiac surgery capacity in sub-Saharan Africa: Quo vadis? Thorac Cardiovasc Surg 2014;62:393-401.
16 Profile Books Ltd. The Economist: Pocket World in Figures 2014 ed. London: Profile Books Ltd.; 2014.
17 List of Countries by Future Population (United Nations, Medium Fertility). Available from: https://www.en.wikipedia.org/wiki/List_of_countries_by_future_population_(United_Nations,_medium_fertility_variant. [Last accessed on 2018 Jun 12].
18 Ozgediz D, Riviello R, Rogers S. The surgical workforce crisis in Africa: A call to action. Bull Am Coll Surg 2008;93:10-6.
19 MacGowan WA. Surgical manpower worldwide. Bull Am Coll Surg 1987;72:5-7, 9.
20 WHO the Abuja Declaration: Ten Years On. Available from: http://www.who.int/healthsystems/publications/abuja_declaration/en/. [Last accessed on 2018 Jun 12].
21 Cohen WJ, Ball RM. Social Security Amendments of 1965. Summary and Legislative History. Available from: https://www.ssa.gov/policy/docs/ssb/v28n9/v28n9p3.pdf. [Last accessed on 2018 Jun 12].
22 Emergency Medical Treatment and Labor Act (EMTALA). Available from: https://www.cms.gov/Regulations-and-Guidance/Legislation/EMTALA/. [Last accessed on 2018 Jun 12].
23 WHO/HA Policy Highlight No. 2/June 2013 (Based on 2010 Data). Available from: http://www.apps.who.int/nha/use/highli2.pdf. [Last accessed on 2018 Jun 12].
24 Rodin J, de Ferranti D. Universal health coverage: The third global health transition. Lancet 2012;380:861-2.
25 Editorial. Universal health coverage - Looking to the future. Lancet 2016;10:2837.
26 Obama B. Repealing the ACA without a replacement - The risks to American health care. N Engl J Med 2017;376:297-9.
27 Gupta AS. Medical Tourism in India: Winners and losers. Indian J Med Ethics 2008;1:4-5.
28 Vaithianathan R, Panneerselvam S. Emerging alternative model for cardiothoracic surgery training in India. Med Educ Online 2013;18:20961.
29 Gladwell M. Outliers: The Story of Success. Little, Brown and Company, New York: Back Bay Books; 2011.